Issues on AILS Operational Concept

Jim Kuchar, MIT
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Specific Comments / Questions on Bob Buley's Viewgraphs

1. Is the paired-approach concept going to be tied to the briefing? If not, briefing title should be changed to "Independent Closely-Spaced Parallel Approaches".

2. Should we state up front that TCAS II cannot provide adequate protection for closely-spaced runways while keeping nuisance alarms acceptable - thus motivating need for ADS-B and the additional alerting system?

3. A minor detail: under "Available Options", one option that is not mentioned is to provide ATC (alone) with specialized CAS algorithms and have ATC notify pilot of blunder via radio — essentially an advanced form of PRM using ADS-B.

Other / General Design Issues

1. Approach Guidance and Navigation

   1.1 VMC Tracking Accuracy: The CAS logic will likely be designed based on aircraft behavior during IMC approaches using DGPS. If a pilot breaks out into VMC, navigational performance may degrade, resulting in nuisance alerts. The robustness of the CAS logic to VMC flight profiles must be determined. This may also place requirements on pilot performance in VMC (e.g., even if VMC, pilot must remain within 1 dot CDI deviation).

   1.2 Need for Collecting Flight Data of Normal Approaches: Alerting system performance can be better tuned if typical aircraft deviations during DPGS approaches can be obtained. Additionally, approach data for aircraft flying closely-spaced parallel operations in VMC are needed.

   1.3 TCAS / ADS-B position comparisons: Requirements on the degree of mismatch between ADS-B and TCAS derived position must be defined. This includes error magnitude and update rate / stale data. TCAS has very accurate range measurements, but altitude is quantized into 100 ft bins and is relatively slow to update.

   1.4 Activation of alert system: The means by which AILS is activated (and TCAS inhibited) must be determined (mode switch, automatic, etc.). Additionally, the conditions under which the system may be activated must be defined (e.g., both aircraft meet minimum equipage and performance specs and cross-talk between aircraft has been verified).

   1.5 Annunciation of system status: The pilot must be informed as to whether AILS is active (and TCAS inhibited).

   1.6 System failure: Procedures for communicating and managing system failures (loss of DGPS, datalink, etc.) must be defined.

2. Alert Generation

   2.1 Multiple Level Alerts: A Caution alert before a Warning alert is advisable, given past research into pilot response times.

   2.2 Alert Sequence: The blundering / deviating aircraft should generally receive alerts earlier than the parallel traffic so that the blunder may be stopped without generating a break-out alert on the innocent aircraft.

2.3 AILS/TCAS Inhibit at Low Altitude: The altitude conditions at which TCAS and AILS alerts are inhibited need to be defined.

2.4 Use of aircraft-specific performance data: Alerting system performance may be better tuned if it uses performance data specific to the type of aircraft and aircraft configuration, as opposed to a single set of algorithms used for all aircraft types. Aircraft-specific algorithms, however, introduce additional design complexity.

2.5 Alert prioiritization: AILS break-out alerts must be integrated and prioritized with other alerts (GPWS, windshear, engine fire, configuration, etc.).

2.6 Indication of alert cause: A single type of break-out command (e.g., “turn-climb”) has the benefit of simplicity, but does not indicate which aircraft is the root cause for the alert. Separate messages would be required to indicate whether the own aircraft is deviating or whether a parallel aircraft is blundering. Whether such indication is required must be determined.

2.7 Pilot ability to cancel alerts: Should/how the pilot be able to cancel AILS alerts (e.g., in response to a known false alarm)? If this is done, will AILS alerts also be canceled on the parallel traffic?

3. Resolution / Escape Maneuvers

3.1 Procedural vs. Adaptive Resolution: A procedural turn-climb break-out maneuver has the benefit of operational simplicity. However, a procedural maneuver is essentially open-loop, and cannot by itself guarantee safe resolution of a conflict. To do so, some form of adaptive system is required that is able to strengthen or weaken the escape maneuver as required. This may be in the form of conventional TCAS “Climb” or “Monitor Vertical Speed” RAs.

3.2 Priority between TCAS Climb RA vs. Procedural AILS Turn-Climb: If combined procedural and adaptive resolution is used (e.g., procedural AILS turn-climb with additional TCAS RA protection), then it must be clear to pilot whether the AILS procedure or TCAS has priority (e.g., which has priority: continue the procedural turn, follow the RA, or continue the turn *and* follow the RA?). Because TCAS logic assumes wings-level vertical RAs, turning during an RA may not provide adequate separation and/or may cause nuisance alarms.

3.3 Turn-Climb Sequencing: Must the escape maneuver be performed as a simultaneous turning climb, or can the turn be performed level followed by climb, or can a climb be initiated followed by a turn? This could be specified through training and/or cockpit guidance, but the robustness of the alerting system solution to variations in pilot actions needs to be determined.

3.4 Availability of Guidance Cues: Unless the escape maneuver is entirely procedural, some form of guidance will be necessary. This may be in the form of conventional TCAS guidance or some other method.

3.5 Conflict with Other Aircraft While Responding to AILS alert: TCAS and AILS must be prioritized or coordinated so that alerts from the two systems do not disagree either during or shortly after performing a break-out maneuver. For example, a TCAS RA to level off runs contrary to the procedural AILS turn-climb.

3.6 Removing TCAS Inhibition: The specific conditions when TCAS inhibits are removed (against parallel traffic) must be defined. There must be a seamless transition from AILS alert to TCAS.

3.7 Controller Takeover: Conditions under which controllers are notified or permitted to assume responsibility for traffic separation must be defined. This may include requirements on separation distance, divergence rate, and methods for indicating to the controller and pilots that authority has been returned to ATC.

4. System Evaluation

4.1 Performance Metrics: Appropriate safety, workload, and nuisance alert metrics must be defined. This is difficult given that blunders are rare and their characteristics may vary.

4.2 Performance Requirements: Specific *values* of the metrics from 4.1 must be determined that define acceptable performance.

4.3 Pilot performance must be evaluated in simulation and flight test to determine typical reaction times and the characteristics (acceleration levels, bank angles, climb rates) of their escape maneuvers.

4.4 Operational behavior: Once fielded, the system should be monitored to observe blunder rates and nuisance alert rates to aid in future improvements. Whether this reporting should be automatic, required, or optional (e.g., ASRS) must be determined.